DOCUMENT RESUME

ED 473 550 RC 023 921

AUTHOR	Anderson, Jock R.; Feder, Gershon
TITLE	Rural Extension Services. Policy Research Working Paper.
INSTITUTION	World Bank, Washington, DC.
REPORT NO	WP-2976
PUB DATE	2003-02-00
NOTE	34p.
AVAILABLE FROM	For full text: http://econ.worldbank.org/view.php?type=5&id=24374.
PUB TYPE	Reports - Evaluative (142)
EDRS PRICE	EDRS Price MF01 Plus Postage. PC Not Available from EDRS
DESCRIPTORS	Access to Information; *Adult Farmer Education; Decentralization; *Delivery Systems; Economic Impact; Efficiency; *Information Dissemination; Models; *Privatization; *Program Effectiveness; Public Policy; Rural Development; *Rural Extension

ABSTRACT

This paper analyzes the considerations that lead policy makers to undertake extension investments as a key public responsibility, as well as the complex set of factors and intra-agency incentives that explain variations in performance between different extension systems. The goals of extension include transferring knowledge from researchers to farmers, advising farmers in their decision making, and stimulating agricultural development. While extension agents often provide services unrelated to farm activities, this paper focuses on agricultural and farm management knowledge dissemination. The paper provides a conceptual framework outlining farmers' demand for information, the welfare economic characterizations of extension services, and the organizational and political attributes that govern the performance of extension systems. The conceptual framework is used to analyze the likely and actual effectiveness of several extension modalities: "training and visit" extension, decentralized systems, "fee-for-service" and privatized extension, and farmer-field-schools. The paper also discusses methodological issues pertaining to assessment of extension outcomes, and reviews the empirical literature on extension impact. Highlighted are the efficiency gains that can come from locally decentralized delivery systems with incentive structures based on largely private provision, although in poorer countries these will still be publicly funded. In wealthier countries, and for particular higher income farmer groups, extension systems will likely evolve into fee-for-service organizations. (Contains 94 references.) (Author/SV)

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RURAL EXTENSION SERVICES

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World Bank Policy Research Working Paper 2976, February 2003

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Prepared for a session in Part B. "Human Resources" of Theme 1: "The Agricultural Producer and Agricultural Productivity," as part of a proposed Volume 3 of the *Handbook of Agricultural Economics*, at the Agricultural Development Retrospective Conference organized by Robert E. Evenson, convened by Yale University, held at Bretton Woods NH, 30-31 September 2002.

The authors have drawn on much of the considerable World Bank experience with extension, including the work of many of our colleagues, most notably Derek Byerlee, Ariel Dinar, David Nielson, Dina Umali-Deininger, Gary Alex, and Willem Zijp. Seniority of authorship is not assigned.

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RURAL EXTENSION SERVICES

Abstract: In this paper we analyze the considerations that lead policy makers to undertake extension investments as a key public responsibility, as well as the complex set of factors and intra-agency incentives that explain why different extension systems' performance varies. Accordingly, the paper provides a conceptual framework outlining farmers' demand for information, the welfare economic characterizations of extension services, and the organizational and political attributes that govern the performance of extension systems. The conceptual framework is used to examine several extension modalities and to analyze their likely and actual effectiveness. Specifically, the modalities reviewed include "Training and Visit" extension, decentralized systems, "Fee-for-Service" and privatized extension, and Farmer-Field-Schools. The paper also provides a discussion of methodological issues pertaining to the assessment of extension outcomes, and a review of the empirical literature on extension impact. The paper emphasizes the efficiency gains that can come from locally decentralized delivery systems with incentive structures based on largely private provision that in most poorer countries will still be publicly-funded. In wealthier countries, and for particular higher income farmer groups, extension systems will likely evolve into fee-for-service organizations.

1. Introduction

It is widely accepted that farmers' performance is affected by human capital, which encompasses both innate and learned skills, including the ability to process information (Jamison and Lau, 1982). Extension services are an important element within the array of market and non-market entities and agents that provide human capital-enhancing inputs, as well as flows of information that can improve farmers' and other rural peoples' welfare; an importance long recognized in development dialogue (e.g., Leonard, 1977; Garforth, 1982; Hazell and Anderson, 1984; Jarrett, 1985; Feder, Just and Zilberman, 1986; Roberts, 1989). The goals of extension include the transferring of knowledge from researchers to farmers, advising farmers in their decision making and educating farmers on how to make better decisions, enabling farmers to clarify their own goals and possibilities, and stimulating desirable agricultural developments (van der Ban and Hawkins, 1996). While extension agents often also provide services that are not directly related to farm activities (e.g., health, non-farm business management, home economics and nutrition), the focus of discussion in this paper is on agricultural and farm management knowledge dissemination (which may include financial and marketing information).

The services provided by extension have significant public-good attributes. It is, therefore, not surprising that there are at least 800,000 official extension workers worldwide, and some 80% of the world's extension services are publicly-funded and delivered by civil servants (Feder, Willett and Zijp, 2001). Universities, autonomous public organizations, and NGOs deliver about 12% of extension services, and the private sector delivers another 5%. There is a corresponding large volume of public budget allocated to extension activities (in 1988, for example, over six billion US dollars worldwide).

From a development policy perspective, the investment in extension services or the facilitation of nongovernment extension, are potentially important tools for improving agricultural productivity and increasing farmers' incomes. More than 90% of the world's extension personnel are located in developing countries (Umali and Schwartz, 1994), where indeed the majority of the world's farmers is located. Yet, the record of extension impact on farm performance is, as we will review, rather mixed. The literature contains analyses indicating very high rates of return on extension investment, as well as documentation of cases of negligible achievements, implying a misallocation of public resources. Clearly, the format by which extension services are rendered, as well as the circumstances in which recipients of extension services operate, will affect the extent of the impact that is observed.

Productivity improvements are possible only if a differential exists between the actual productivity on the farms and what could potentially be produced with better know-how, subject as always, to farmers' preferences and resource constraints. In the past, rapid technological advances have created such a differential in many developing countries (e.g., Feder, Lau and Slade, 1987). This productivity differential can be broadly classified into two types of "gaps": a technology gap and a management gap. The former might entail additional investment and higher recurring costs (e.g., for inputs such as seeds of improved cultivars or fertilizers) while the latter may offer the farmer a low-cost means of raising productivity by applying improved management practices (e.g., Byerlee, 1988). These gaps are, in the first instance, a manifestation of the difference in the knowledge that farmers possess and the best-practice knowledge that exists at any point of time. Best practice is often, though not always, an embodiment of the latest science-based developments addressed to overcoming the limitations imposed by traditional technology and practices and thereby enhancing productivity. To realize their potential impact, however, the scientific advances must be aligned to the local agroecological and socioeconomic characteristics of the target areas.

Extension helps to reduce the differential between potential and actual yields in farmers' fields by accelerating technology transfer (i.e., to reduce the technology gap) and helping farmers become better farm managers (i.e., to reduce the management gap). It also has an important role to play in helping the research establishment tailor technology to the agroecological and resource circumstances of farmers. Extension thus has a dual function in bridging blocked channels between scientists and farmers: it facilitates both the adoption of technology and the adaptation of technology to local conditions. The first involves translating information from the store of knowledge and from new research to farmers, and the second by helping to articulate for research systems the problems and constraints faced by farmers.

The adoption of technology by farmers is inevitably affected by many factors (e.g., Feder, Just and Zilberman, 1986). Adoption can be influenced by educating farmers about such things as improved varieties, cropping techniques, optimal input use, prices and market conditions, more efficient methods of production management, storage, nutrition, etc. To do so, extension agents must be capable of more than just communicating messages to farmers. They must be able to comprehend an often complex situation, have the technical ability to spot and possibly diagnose problems, and possess insightful economic-management skills in order to advise on more efficient use of resources.

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Effective extension involves adequate and timely access by farmers to relevant advice. However, while access to appropriate information is necessary to improve agricultural productivity, it is not sufficient. In general, farmers will adopt a particular technology if it suits their socioeconomic and agroecological circumstances. The availability of improved technology, access to "modern" inputs and resources, and profitability at an acceptable level of risk are among the critical factors in the adoption process. Further, farmers often get information from a number of sources. Public extension is one such source, but not necessarily the most efficient. Extension can increase the rate at which adoption occurs, but the extent and form that an extension service takes should be guided by considerations of cost-effectiveness and the nature of extension products. Thus, while extension, including that done in the public sector, can play an important role in improving the productive efficiency of the agricultural sector, the virtues and limitations of the alternative mechanisms need to be considered in assessing the cost-effectiveness of delivering information (e.g., Byerlee, 1998; van den Ban, 1999), and this is the task taken up in sections 2 and 3 below.

Extension usually has maximal impact in the early stages of dissemination of, say, a new technology, when the informational disequilibrium (and the "productivity differential") is the greatest. Over time, as increasing numbers of farmers become aware of a specific technological thrust, the impact of such extension diminishes, until the opportunity and need for more information-intensive technologies (Byerlee, 1998) arise. The dynamic resolution of the information disequilibria associated with specific extension "messages" makes observing the impact of extension difficult. At the same time, the uneven flow of benefits from any particular extension message has significant implications from a policy and program design point of view (e.g., Simmonds 1988). The cost-effectiveness of information delivery at a given point in time should thus be established in the light of current and future benefits and costs in order to justify the marginal resources allocated to delivering the information, and aspects of this perspectives are pursued in section 4 below.

Market distortions and infrastructural bottlenecks further affect the adoption of new technology and can help or hinder the effectiveness of extension services. Again, from an operational point of view, the cost-effectiveness of delivering messages must be considered within the prevailing policy and market environment. A restrictive environment has a high opportunity cost in terms of foregone benefits from extension advice, creating a divergence between potential and actual benefits. The prevailing policy regime thus has potentially important implications for an appropriate sequencing of policy interventions and program design.

The wider context of extension services, defined broadly as the rural knowledge and innovation system, has been recently overviewed by Alex, Zijp and Byerlee (2002), who argue that such services are key to informing and influencing rural household decisions. Unfortunately, rural areas usually lag behind urban areas in their access to information, and developing countries generally lag behind more developed countries in this regard. Such lags jeopardize the ability of rural people to realize their full potential and improve their economic, social and environmental conditions. Rural information services are, they argue, key to unleashing the potential of rural peoples and enabling them to change their living situations and bring about sustainable rural development.

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In this paper we endeavor to analyze the considerations that lead policy makers to undertake extension investments as a key public responsibility, as well as the complex set of factors and intra-agency incentives that explain why different extension systems' performance varies. The variation in extension outcomes is demonstrated in a review of the empirical results of studies focusing on extension effects. Accordingly, section 2 provides a conceptual framework outlining farmers' demand for information, the welfare economic characterizations of extension services, and the organizational and political attributes that govern the performance of extension systems. Section 3 examines several extension modalities and analyzes their likely and actual effectiveness. This is followed in section 4 by a discussion of methodological issues pertaining to the assessment of extension outcomes, and a review of the empirical literature on extension impacts. The final section 5 highlights the conclusions.

2. Conceptual Frameworks

2.1 Information as an Input to Productivity Growth—Demand for Information

Putting aside farming as a way of life, running a farm business can be thought of as deliberate management of diverse inputs—land, labor, physical capital of many types, and not to be forgotten, information—for producing outputs of value that can be consumed or traded to enhance the welfare of the dependent household. Extension as broadly conceptualized in this paper is focused on the delivery of the information inputs to farmers. Information can be of many types, ranging from anticipated future prices for farm products, to new research products such as improved crop cultivars, to knowledge about techniques involved in using particular inputs, such as timing and intensity of use of fertilizer (e.g., Byerlee, 1998). As a productive input, farmers thus have a demand for information and depending on how productive it is perceived to be may be prepared to pay for it as they would for other purchased inputs (e.g., Dinar, 1996).

Yet information is a rather special type of input in many respects. Some information will have quite enduring value, such as when transferred managerial skills are encapsulated in the human capital of the farm manager, and such values are generally increasing over time as more complex and increasingly integrated managerial challenges are faced. At another extreme, some information may have quite ephemeral value, such as a forecast of tomorrow's wheat price in a local market. At an intermediate level, the value of input management information for a particular cultivar is likely as obsolescent as the cultivar itself. Clearly, different types of information can thus have many different inherent valuations to concerned farmers. In some cases, especially where the consequences of using the particular information include environmental outcomes, such as reduced soil erosion that might come with adoption of no-till farming (Pieri et al., 2002), or with reduced overuse of fertilizer nitrogen (Byerlee, 1998), the value of the information may go to many beneficiaries beyond the farm gate.

It is not surprising then that the delivery systems for supplying information can have diverse values to different client farmers, so getting a handle on the value of extension to farmers is not a trivial task, which may explain why it has so seldom been tackled. The task is made more challenging by the multitude of alternative suppliers of information; from friends and neighbors, to input supply firms and specialized consulting services, to media, to a government extension

service. The complexity of the situation is instructively illustrated by Gautam (2000, p. 3) in his Figure 1.1.

Taken together, the information delivery systems supporting farming should constitute something of a growth industry if, as is regularly argued by agricultural analysts, farming is becoming more information intensive (Byerlee, 1998). How the demands are met by supplies surely varies greatly around the world, depending on market and institutional conditions. Gautam (2000), for instance, concludes that there is a significant unmet demand in Kenya for general agricultural extension services. Just how different types of information are best delivered depends crucially on (a) the nature of the information concerned, a topic taken up in the following section, and (b) the type of farmer.

2.2 Welfare Economics Contextualization

The world of Adam Smith's perfect markets is seldom to be found in the environment in which most rural dwellers operate, especially those in the developing countries. The necessary conditions for such perfection include rivalry, excludability, appropriability, symmetric information, complete markets with no distortions or externalities, as is so effectively reviewed in the context of agricultural extension by Hanson and Just (2001). They appraise the extent of market failures along this spectrum for the case of farming in Maryland but their diagnosis of the prevalence of such failures surely applies to many if not most farming situations around the world. Several of the departures from perfection that they identify are returned to in section 3 when we consider mechanisms that have been proposed for overcoming some of the problems of providing largely public-good extension products.

It has become almost standard to focus particularly on the first two elements of possible market failure in considering whether extension services are mainly public or private goods based on a distinction using the principles of excludability and rivalry (e.g., Umali and Schwartz, 1994). Excludability occurs when farmers who are not willing to pay for a service can be excluded from its benefits, such as tailor-made farm management advice. Rivalry occurs when one farmer, by using advice, reduces its availability to others, such as services embodied in commercial products. Rivalry and excludability are high for private goods and low for public goods. Other services are toll goods, characterized by high excludability and low rivalry, when some farmers can be excluded from access, even though their value to users is not diminished by use by others or common pool goods, characterized by low excludability and high rivalry (Table 1). As noted in section 2.1, the value of information may be influenced by time and place, as for example, market information that decreases in value as the information becomes more widely disseminated and markets adjust, or weather forecasts that have zero value after the event.

Table 1: Extension products by the nature of economic characteristics of information (based on Umali and Schwartz, 1994, Figure 3.2, p. 24).

		Excludability	
		Low	High
Rivalry/Subtractability	Low	**Public Goods** ♦ Mass media information ♦ Time insensitive production, marketing, and management information of wide applicability	**Toll Goods** ♦ Time-sensitive production, marketing, or management information
	High	**Common Pool Goods** ♦ Information embodied in locally available resources or inputs ♦ Information on organizational development	**Private Goods** ♦ Information embodied in commercially available inputs ♦ Client-specific information or advice

Knowledge delivered by extension may be information embodied in inputs or equipment (e.g., improved seed or machinery) or more abstract, disembodied information on agricultural practice. Information embodied in inputs or equipment has high rivalry and tends to be a private good when the input or equipment must be purchased, and a common pool good when the input is locally available. There are two broadly applicable types of disembodied agricultural information: **general, non-excludable information** (e.g., market information, cropping patterns, etc.), which tends to be a public good, and **specialized, excludable information** (e.g., fertilizer recommendations for a specific field or farm operation), which tends to be a toll good (Umali-Deininger, 1996).

The diverse types of knowledge and information can be provided by the public or private sector, or by civil society, another often important player in service provision. Different mechanisms are available for coordinating the supply of services—private-sector markets, public sector hierarchies with state authority, and collective action by civil society (Picciotto, 1995; Wolf and Zilberman, 2001). The characteristics of an information service influence whether it is best supplied by the private, voluntary or public sectors (Schwartz and Zijp, 1994; Umali-Deininger, 1996). Some implications of these observations drawn out by Picciotto and Anderson (1997) are that:

- Information closely associated with market goods (e.g., purchased inputs) is generally best left to the private sector;
- Information associated with toll goods can be effectively provided by combined public and private sector efforts;
- Information relative to management of common pool goods (forests, common grazing lands, water when it is not already subject to quota rules) is usually best provided by cooperative or voluntary institutions; and
- Only when market and participation failures are high should information provision be financed by the public sector and, even in these cases, the public sector might well finance private service delivery.

(i) Private Extension Services and Cost Recovery

The private-good nature of many extension services has raised interest in privatizing extension services (e.g., Cary, 1993, 1998; Lindner 1993). Indeed, as Vernon Ruttan has reminded us, this theme takes us back to the initial formal extension efforts in the US Mid-West when the Farm Bureaus hired county extension agents to provide the information services they demanded. In reality now, most information services are provided outside of government, and farmers see public extension as only one option—perhaps even a last resort—in obtaining needed information services. The government has, however, a major role in establishing policies and programs to encourage development of private extension services, along with continued sustenance in some cases, and extension systems need to be designed with the understanding that they will be cost-effective only "if the public role is defined so as to complement what the private sector can and will fund and deliver" (Beynon with others, 1998, p. 135).

Private consulting or advisory services generally address needs of commercial farmers. Developing private services for small-scale farmers often necessitates public investment to develop capacities of service providers and establish markets for services. Veterinarians and para-vets have pioneered private service provision in some countries (Umali, Feder and de Haan, 1994; de Haan et al., 2001) and, in crop agriculture, pest control services present the same opportunities for private service delivery. Contracting schemes are another private-sector mechanism for providing services to small-scale farmers (Mullen, Vernon and Fishpool, 2000; Rivera and Zijp, 2002). The potential for conflict of interest in such arrangements may warrant a public regulatory and monitoring function backed up by public information, for quality checking on information supplied.

User financing mechanisms are a means of obtaining private financing to cover at least a portion of the cost of public extension services. Mechanisms include levies, direct user charges, or subsidies for services procured by users. Levies are most easily assessed on commercial crops with a highly centralized marketing system and a limited number of producers or processors. User charges are more feasible for highly commercial operations, for more sophisticated producers, and for services that provide a clear and immediate benefit. Latin America has seen extensive experimentation with co-financing and private extension service provision (e.g., Keynan, Manuel and Dinar, 1997; Dinar and Keynan, 2001), and small-scale farmers in various

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countries have indicated a willingness to pay for extension services that meet their needs (e.g., Gautam, 2000; Holloway and Ehui, 2001). A possible caveat to private user-pays extension is that, when farmers pay for extension information, they may be less willing to share that information freely with neighbors (van den Ban, 2000). This may significantly slow the spread of innovation. Producers may also want less intense service provision than is sometimes offered by public agencies (Gautam, 2000). Practical issues that emerge in such changing private-public provision of services include an effective crowding out of public provision to the more remote clients when, by losing much of their traditional core business, such public providers incur diseconomies of size (such as for training) and scope for the provisioning task they are left with (Hanson and Just, 2001).

(ii) Public Financing of Extension

Public investment in extension is justified when the general public benefits more than the extension client, when government can provide services more cheaply or better, when extension services directly facilitate other programs, or when the private sector does not provide needed services (van den Ban, 2000). These conditions apply when there are positive externalities to innovation or market failure in service provision. Market failure is often due to: unorganized demand (small farmers do not recognize potential benefits, have limited purchasing power, and are not organized to access services) or unorganized supply (few individuals or institutions are capable of providing technical services or there is limited opportunity for private firms to charge for provision of easily disseminated information). The most important externalities are: positive environmental (e.g., Byerlee, 1998; Mullen, Vernon and Fishpool, 2000) and health (human, livestock and crop) impacts of appropriate technology use; improvements in political stability and poverty reduction resulting from improved equity in access to information; and improved national security, economic development and food security resulting from increased agricultural productivity, competitiveness and sustainability (e.g., Thirtle, Lin and Piesse, 2002). Consumers often benefit more from increases in productivity than do farmers.

Despite the fact that public financing for extension services is often justifiable, the general trend towards fiscal restraint and a reduced role for the public sector has led to financial crises in many extension services. Two general options for improving financial sustainability of public extension involve scaling back public programs or improving cost-effectiveness (Beynon with others, 1998). Scaling back public programs might involve: reducing coverage to specific target farmer groups, reducing intensity of coverage (less frequent visits, fewer services), devolving service provision to private organizations or requiring cost sharing by users (Wilson, 1991). State withdrawal from service provision might entail total abandonment of some programs or shifting of service responsibilities to others—requiring commercial farmers to arrange their own services; encouraging producer organizations to provide services; or promoting private extension by input suppliers (notwithstanding potential conflicts of interest in the content of advice), produce buyers, NGOs, environmental groups, or others. Improving cost-effectiveness can be achieved through improvements in program management, targeting and priority setting, and choice of appropriate extension delivery methods (e.g., greater use of mass media).

Sustainability of an extension service depends crucially on its ability to provide benefits and generate support from internal and external stakeholders (Gustafson, 1994). Improving efficiency and quality of service provision and client involvement in priority setting help to generate needed support. True farmer ownership of programs adds significantly to program sustainability (Scarborough et al., 1997).

(iii) Public-Private Partnerships

There is growing recognition that, even where public financing of extension is justified, private service delivery is often more efficient in serving clients. This leads to strategies for contracting extension services—delinking funding from service delivery. Contracted extension strategies take many different approaches to division of responsibilities for financing, procurement, and delivery of services, but most reforms involve public funding for private service delivery (Rivera, Zijp and Alex, 2000). Competitive contracting instills a private-sector mentality of cost-consciousness and results-orientation, even in public institutions too when they are forced to compete in providing services.

Contracted extension systems seek to reduce costs and improve cost-effectiveness of public extension services, but most current reforms go further and attempt to draw on private-sector funding to improve financial sustainability of extension. Table 3 illustrates the alternative arrangements possible in public and private financing and provision of extension services. These include the traditional public-sector extension services, fully private services, and public-private partnerships involving some type of contractual relationship.

Table 2 Some alternatives for public-private financing and provision of extension services (according to Alex, Zijp and Byerlee, 2002)

		Finance Provision		
		Public	**Private (Farmers)**	**Private (Other)**
Service Provision	**Public**	♦ Traditional extension	♦ Fee-for-service extension	♦ Contracts with public institutions
	Private	♦ Subsidies to extension service providers ♦ Publicly-financed contracts for extension services	♦ Commercial advisory services ♦ Sale of newspapers, magazines	♦ Information provided with sale of inputs ♦ Extension provided to contract growers ♦ Advertising in newspapers, radio, television, magazines

The economic rationale for farmers to pay for extension services is generally clear and the trend toward such user payment is well established in OECD countries (e.g., Hone, 1991; Marsh and Pannell, 2000). In developing countries, many producers are unable or unwilling to pay for services as they have not seen examples of effective, responsive extension. Another constraint limiting private extension is that many countries have few extension service providers outside the public sector. Furthermore, few public institutions have incentives and institutional arrangements in place to encourage program cost-recovery.

2.3 A Conceptual Framework for Analyzing Extension Organizations

Earlier sections established the fact that many aspects of extension work entail strong public-good characteristics and other market failures that are not easy to overcome through taxes, subsidies and regulatory interventions. It is thus not surprising that public provision of extension services (whether by central or regional governments) has been common in most countries, at least at some stage of their history. While there have been some notable successes, it has also been observed, quite often, that public extension systems demonstrate weaknesses hampering their effectiveness. A recent worldwide review by Rivera with Qamar and Crowder (2001, p. 15) refers to extension systems as "failing" and "moribund", being in a state of "disarray or barely functioning at all". Similar observations have been made in the past by others (e.g., Kaimowitz, 1991; Ameur, 1994). It is conceivable that there are some generic and universal difficulties in the operation of public extension systems, and in the typical bureaucratic-political environment within which they are budgeted and managed.

This hypothesis has been propounded by Feder, Willett and Zijp (2001), who suggest eight interrelated characteristics of public extension systems, which simultaneously affect each other, and which jointly can cause observed manifestations of deficient performance, low staff morale and financial stress. The characterization provides a framework to analyze the observed conduct of different levels of extension personnel, and of the performance of the system as a whole. The approach also helps in analyzing the underpinnings of different organizational forms, as well as in predicting their likely performance. These characteristics of public extension systems are considered here under the eight headings that follow.

(i) Scale and Complexity

In countries where the farm sector comprises a large number of relatively small farmers (as is common in most developing countries), the clients of extension services live in geographically dispersed communities, where the transport links are often of low quality, adding to the cost of reaching them. The incidence of illiteracy and the limited connections to electronic mass media can further limit the ability to reach clients via means that do not require face-to-face interaction (e.g., written materials, radio, television, internet). Thus, the number of clients that need to be covered by extension is large, and the cost of reaching them is high. The challenge is complicated further by the fact that farmers' information needs vary even within a given geographical area due to variations in soil, elevation, microclimate and farmers' means and capabilities. The large size of the clientele (all of whom are entitled to the public service in the common case of free extension) inevitably leads to a situation where only a limited number of farmers have direct interaction with extension agents. Since direct contacts are rationed, agents often exercise selectivity as to which farmers they interact with, and the selectivity often manifests preference for larger, better endowed, and more innovative farmers, who can provide some in-kind payment, as well as reflect better performance (Axinn, 1988; Feder and Slade, 1993). This sort of supply-side rationing is exacerbated by self-selection on the part of farmers, where those with a higher value (larger demand) for information tend to be large-scale farmers, with better opportunities to take advantage of information. The selectivity of contacts has ramifications in terms of the likely extent of diffusion of information through farmer-to-farmer communications. As those who tend to receive more extension contact are often not typical of the farming population, there is often a lesser inclination of other farmers to follow the example of contact farmers, or to seek advice from them (in spite of some contrary positive experiences, such as in Israel (Keynan, Olin and Dinar, 1997)). This reluctance thus often diminishes the potential impact of extension services across the farm population.

On the aggregate extension supply side, the reaction to the large clientele is the deployment of large numbers of agents, which then pose a management challenge, if the organization is national or handled by large georgraphical-administrative units (e.g., states or provinces within a federal system). In organizations with a large number of field personnel, there is a tendency to adopt a hierarchical centralized management system, so as to facilitate the monitoring of the large and dispersed field-level labor force. The large and hierarchical bureaucracy is characterized by a top-down management style, and is thus not conducive to participatory approaches to information delivery and priority setting (e.g., Waters-Beyer, 1989; Fleischer, Waibel and Walter-Echols, 2002). Furthermore, the many layers in the hierarchy remove the decision making from the field level, and lead to suboptimal decisions.

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(ii) Dependence of Extension on the Broader Policy Environment

The effectiveness of extension work is crucially dependent on complementary policy and institutional actions on which it has very limited influence. Thus, limiting factors such as credit, input and seed supplies, price incentives, marketing channels and human resource constraints determine the impact of the information that extension agents convey to farmers. While extension agents can adjust their advice, given the overall policy climate, the value of the information is diminished when the terms of trade are tilted against agriculture, rural infrastructure investment is inadequate, and farmers have irregular input supplies due to absent input markets (Axinn, 1988). The coordination between agencies that influence these complementary factors and extension management is costly and difficult, and the degree of leverage that can be brought by extension is minor. The negative implications of this situation are particularly pronounced when one examines the poor record of linkages to the knowledge generation system, especially the national agricultural research system (e.g., Ewell 1989), which is examined separately next, given its importance for extension performance.

(iii) Interaction with Knowledge Generation

In contrast to the situation in the US, where the cooperative extension service is embedded in the university system, the information on which extension advice is based in most developing countries is not generated within the extension organization itself but rather largely with separate systems (national agricultural research institutes and universities, and increasingly also private research firms), under separate management structures and subject to incentive systems where extension opinions and priorities often do not carry a significant weight. Because the performance indicators for research systems are often related primarily to recognition within the scientific community, the areas of priority are not necessarily aligned with what extension managers perceive as priorities, given their farm-level feedback (Kaimovitz, 1991). The public research and extension organizations often compete for budgets (as they are commonly located within the same ministry). Researchers typically enjoy a higher status (they are often better educated and have greater independence), and this produces tensions in the interactions between research managers and extension, which is not conducive to coordination and to a two-way feedback. The outcome is detrimental to extension effectiveness, as the information available to agents may not be specifically tailored to the problems faced by farmers, given their resource constraints (e.g., Mureithi and Anderson, 2002, on the situation in Kenya). A review in the World Bank of a large portfolio of extension projects (Purcell and Anderson, 1997) pointed out that research-extension linkages were generally weak, and neither research nor extension was sufficiently conscious of the need to understand the constraints and potentials of the different farming systems as a basis for determining relevant technology and technology development requirements. Consequently, the inadequate research-extension links led to adverse outcomes in a large proportion of the projects reviewed, and claims of insufficient relevant technology were frequently found. More recent World Bank operations have naturally built on the lessons of experience, so the contemporary landscape of extension-type interventions (including support for business development services assisting small and medium enterprise) differs greatly from that of earlier decades.

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(iv) Difficulty in Tracing Extension Impact

Because many factors affect the performance of agriculture in complex and contradictory ways, it is difficult to trace the relationship between extension inputs and their impact at the farm level. This difficulty, in turn, exacerbates other inherent problems related to political support, budget allocation, incentives of extension employees, and their accountability, both upwards (to the managers) and downwards (to their clients).

As discussed further in section 4, the evaluation of extension impact involves measuring the relationship between extension and farmers' knowledge, adoption of better practices, utilization of inputs, and ultimately farm productivity and profitability and the related improvement in farmers' welfare. But farmers' decisions and performance are influenced by many other systematic and random effects (prices, credit constraints, weather, other sources of information, etc.), and thus ascertaining of the impact of extension advice to farmers requires fairly sophisticated econometric and quasi-experimental methods (section 4). The decision makers who allocate funds, and even the direct extension managers, face great difficulties in assessing the impact of extension and in differentiating it from other contributing factors, or making allowances for the effects of counterveiling factors.

Given the difficulty in relating cause to effect, extension input indicators are often adopted as "performance" criteria, as they are cheaper and simpler to establish (Axinn, 1988). Thus, the volume of contacts, numbers of agents, numbers of demonstration days, etc. are used to judge whether extension is effective or not. These, of course, are not necessarily indicative of the quality and relevance of the knowledge conveyed.

The inability to attribute impact and thus assess performance has adverse impact on the incentives of extension staff to exert themselves in outreach to farmers. The motivation to train and update knowledge is hampered too (as the improved performance that such training brings cannot be observed). Time is spent on collecting and reporting input indicators, as these are easier to obtain. There are some other perverse outcomes that result from the adverse impact on incentives, which are discussed below. All of these are likely to produce lower quantity, as well as deficient quality, in extension work.

(v) Accountability

As in any public bureaucracy, extension personnel are accountable to the managerial cadres, but because the effectiveness of their activities cannot be easily established, their performance is measured in terms of input indicators that are easy to provide and confirm. The field staff are thus practically not accountable for the quality of their extension work, and often even the quantity can be compromised with impunity. The higher level managers are nominally accountable for extension performance to the political level but, due to the same impact attribution problems, the extension system's performance is monitored in terms of budgets, staff levels, and other bureaucratic, rather than substantive, indicators. As is common in other large bureaucracies that are fully publicly funded, the accountability to the clientele (i.e., to the farmers) is only nominal, as typically there is neither a mechanism, nor incentives, to actually induce accountability to farmers (Howell, 1986). This is ironic, as the farmers are the only ones

who can relatively easily observe the quality and effectiveness of the extension service they receive. In the absence of mechanisms to implement accountability to farmers (which would improve the effectiveness of extension), incentives are distorted. Non-extension activities, for which extra remuneration can be earned, such as promotion of certain inputs for which a commission can be secured, or intermediation in the acquisition of credit (e.g., assistance in filling forms), are undertaken by agents, as the amount of extension time diverted to these tasks cannot be easily detected. If such tasks are formally extension agents' responsibilities (as they are in some systems), they will tend to get higher priority than information dissemination duties (Feder and Slade, 1993).

Earlier extension projects yielded evidence of accountability failures in many cases. Little attention was given to the introduction of systematic participation by the farming community in problem definition, problem solving, and extension programming. In more than one-half of the projects reviewed, an "entrenched top-down" attitude by staff was noted, and, not surprisingly, three-quarters of failed extension projects were characterized by such conduct (Purcell and Anderson, 1997).

That this pattern of behavior has been so common in both more- and less-developed countries, and is derived from a common distorted incentive system, is evident from the comments of Hercus (1991, p. 25), characterizing the New Zealand extension service prior to its reforms, as an operation where the budget used was accounted for in terms of "activities, not results, and concerned almost exclusively with expenditure and hardly at all with outputs or efficiencies. The mandate of extension was derived by the...service itself, and in the absence of any challenge or alternative definition by the taxpayers' representatives, the service regarded its charter as the right to exist on the prevailing terms and conditions."

(vi) Weak Political Commitment and Support

Urban-bias has traditionally made agriculture a weaker contender for public investment resources in countries where agriculture is a large sector (Binswanger and Deininger, 1997). But even given this situation, extension tends to be a less powerful claimant for budgets. The review of extension operations assisted by the World Bank (Purcell and Anderson, 1997) pointed out that, in nearly one-half of the projects examined, lack of commitment and support by senior government officials adversely affected implementation and funding. Indeed, the failure to allocate funds is a key indicator of weak conviction by senior decision makers and, as reported by Umali-Deininger (1996), an overwhelming majority of extension projects in her review recorded inadequate operating funds. Feder, Willett and Zijp (2001) posit that a plausible reason for the lack of adequate support (and the resulting limited funding) by politicians and senior officials is the inability to derive political payoff that can be earned from a public outlay that has a visible impact (e.g., the double cropping that will follow from an irrigation investment, or the reduction in transport cost due to a bridge). Such a payoff cannot be obtained from an expenditure that has an unclear cause-effect nature, such as has sometimes been said of extension. In addition, it is possible that awareness of the deficient accountability, and the overall impression of ineffectiveness, deter policy makers from allocating budgets to extension services.

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(vii) Encumbrance with Public Duties in Addition to Knowledge Transfer

Because the extension service typically has a large number of public servants functioning at the rural community level, governments are often inclined to utilize extension staff for other duties related to the farming population. Such duties include collecting statistics, administering loan paperwork and input distribution (for government-provided inputs), implementing special programs (e.g., erosion control), and performing regulatory duties (Feder and Slade, 1993).

Many of these duties are easier to monitor by supervisors than the information dissemination function, as there are clear and quantifiable performance criteria (e.g., the number of loan applications returned or the submission of statistics reports). Consequently, extension staff naturally place greater attention on the accomplishment of these duties. Furthermore, there may be an extra monetary incentive in performing these other duties (such as input distribution) as some rents can be derived from handling services that have a clear cash value to the recipient farmer. The allocation of an inordinate amount of an extension agent's time to these duties, at the expense of time for technological information dissemination, can go undetected because the outcome of the core extension duty is so difficult to attribute, and because accountability to farmers is deficient. Swanson, Farner and Bahal (1990) estimate a diversion of as much as 25% of the education effort. Such patterns of behavior will tend to reduce the productivity impact of extension, and, over time, may exacerbate the image of ineffectiveness. A contrary view is that such "diversion" means that at least *something* gets delivered to (some of) the clients!

(viii) Fiscal Sustainability

Some of the preceding characterizations of public extension systems lead to persistent funding difficulties. The public-good nature of many extension services makes cost recovery at the individual beneficiary level difficult. The dependence on public funding, in turn, is problematic because weak political commitment implies lower budgets, relative to the large clientele that needs to be served. The image of ineffectiveness and of unenforceable accountability is possibly another reason for the reluctance to direct large budgets to extension. As pointed out by Howell (1985), a cyclical pattern may be observed, whereby, in years when budget is relatively large (such as when a foreign donor infuses funds for extension), large numbers of staff are recruited, imposing a large fixed cost on the extension service (public employees typically are tenured). When budgets dwindle, the fixed staff costs claim a large share of available funds, and field operations are curtailed (as they require funds for transport and living expenses), as well as other recurrent costs (vehicle maintenance, replacement of agents' modes of transport, etc.). The scaling down of field operations reduces not only the quantity of extension inputs, but also their quality, as the extent of feedback from farmers is reduced, and thus timely follow-up on farmers' issues is hampered. References to fiscal inadequacy, and the consequent unsustainability of extension operations, are common in the extension literature (e.g., Howell, 1985; Röling, 1986; Ameur, 1994; Feder, Willett and Zijp, 2001; Hanson and Just, 2001). Purcell and Anderson (1997) cited funding shortfalls as such a common phenomenon that over 70% of the extension projects in their sample of Bank-supported operations faced "unlikely" or "uncertain" sustainability. More recently this theme has come up for critical attention in the wider development literature (e.g., Kydd et al., 2001).

3. Extension Modalities as Induced Institutional Innovations

The discussion above provided a framework that explains a number of "stylized facts" regarding the structure, operations, and performance of public extension systems. In this section we utilize this framework to analyze a number of specific formats of extension operations that have emerged in the past three decades. These newer approaches, which depart from the traditional public service models as described in section 2.3, may be viewed as induced institutional innovations and reforms, often pluralistic (e.g., Anderson, Clément and Crowder, 1999; Anderson 1999; FAO/WB, 2000), where specific design features reflect attempts to overcome some of the weaknesses inherent in the public extension systems of recent decades.

3.1 Training and Visit (T&V) Extension

The T&V model of extension organization was promoted by the World Bank between 1975-1995 as a national public extension system, with application in more than 70 countries (Umali and Schwartz, 1994). The system's designers stressed the following features: (i) a single line of command, with several levels of field and supervisory staff; (ii) in-house technical expertise, whereby subject matter specialists are to provide training to staff and tackle technical issues reported by field staff; (iii) exclusive dedication to information dissemination work; (iv) a strict and predetermined schedule of village visits within a two-week cycle where contacts are to be made with selected and identified "contact farmers"; (v) mandatory bi-weekly training emphasizing the key set of messages for the forthcoming two-week cycle; (vi) a seasonal workshop with research personnel; and (vii) improved remuneration to extension staff, and provision of transport (especially motorcycles and bicycles). It is evident that the T&V design attempts to tackle directly or indirectly some of the weaknesses highlighted above. But as we will argue, some of the modifications exacerbated other weaknesses, and the ultimate result was a widespread collapse of the structures introduced.

The issue of scale and complexity was handled by heavy reliance on officially selected contact farmers within an identifiable farming group. By working with a small number of contact farmers (six to eight per group of about 100), agents were to maximize coverage. But the required staff-farmer ratios implied a significantly larger extension staff, and thus the costs of T&V extension systems were higher by some 25%-40% than the systems they replaced (Feder and Slade, 1993; Antholt, 1994). This made T&V extension more dependent on public budget allocations. The design intended to tackle the accountability issue by improving management's ability to monitor staff activities, taking advantage of the strict visit schedule, the identifiable contact farmer, and the intensive hierarchy of supervisory staff. This would have indeed provided incentives for compliance with expectations regarding the quantity of service delivered. The monitorable daily activities schedule also eliminated much of the ability to divert time to activities other than information dissemination (which were formally removed from extension duties). But the quality of extension service was not practically monitorable, and ultimately the impact of extension could not be observed by managers and policy makers. The lack of accountability to farmers was not resolved. The interaction with research was improved through the seasonal meetings but in practice little influence was gained regarding the setting of research priorities.

Some of the features of the design could not stand up to practical realities. For example, the "contact farmer" approach was often replaced by a "contact group" approach because biases in the selection of contact farmers (universally observed due to extension agents' incentives) led to diminished diffusion. The strict bi-weekly visit schedule could not be maintained because often there were no important new messages that needed to be conveyed, and the farmers had limited interest in frequent visits. The consequences for extension impact were apparently negative. While a study by Feder, Lau and Slade (1987) showed a positive impact on yields in Haryana (India) three years after project initiation, studies in Pakistan (Hussain, Byerlee and Heisey, 1994) and in Kenya (Gautam, 2000) indicated no significant impact after a longer period.

Many observers, including early skeptics such as Moore (1984), agree that the single most crucial factor that eventually brought about the dismantling of the T&V extension system was the lack of financial sustainability, a generic problem made worse by the higher cost of the system. As the ability to demonstrate impact was not improved, there was no significant change in the political commitment to support extension, and, in country after country, even in long-faithful India, once the World Bank ceased funding (assuming that the new system has been "mainstreamed"), the local budget process implied a return to the smaller funding levels of the past. With lower funding, the T&V system could not be sustained and hard-pressed governments have struggled with downsizing options, in some cases supported directly by bilateral donors, inevitably coupled with other extension reforms (e.g., Sulaiman and Hall, 2002).

3.2 Decentralization

The decentralization of extension services retains the public delivery and public funding characteristics of traditional centralized extension, but transfers the responsibility for delivery to local governments (district, county, etc.). Several Latin American governments have undertaken this approach (Wilson, 1991) in the 1980s and 1990s, and it is being initiated in African countries such as Uganda (e.g., Crowder and Anderson, 2002). The main expected advantage of the approach is in improving accountability, as agents become employees of local government, which (if democratically elected) is keen on receiving positive feedback on the service from the clientele-electorate. This was expected to improve extension agents' incentives, and induce better service. Some advantages may also be realized in coordinating extension advice with activities of other agencies, as presumably the costs of coordination are lower for local agencies operating in a smaller geographical area. There may also be better political commitment as the clientele is closer to the political leadership. But decentralized extension agencies also face a multitude of additional problems. There is greater potential for political interference and utilization of extension staff for other local government duties (including election campaign activities). Economies of scale in training and the updating of staff skills can be lost. Similarly, extension-research linkages are more difficult to organize. An analysis (Garfield, Guadagni and Moreau, 1996) of Colombia's experience with the decentralization of extension confirms these concerns, and documents a significant increase in the aggregate number of staff (and thus in aggregate costs). Issues of financial sustainability may, therefore, not have been resolved, but merely transferred to the local level.

A variant of decentralized extension is the devolution of extension functions to farmers' associations, rather than to local governments, a strategy pursued in several West African countries, and where there have been some notable successes (e.g., Guinea). This format is likely to have a greater impact on accountability, as the employer represents even more closely the clientele, and thus the incentives for higher quality of service are better. There is also a better potential for financial sustainability, as the farmers' association that provides the public good is better able to recover costs (say, as general membership fees) from its members, although typically government funding is also provided to the associations. Extension agents may be permanent employees of the associations, or contract employees from private entities, NGOs, or universities; conceptually, their incentives for better service are fairly similar regardless of their standing. The difficulties with maintaining agents' quality due to loss of economies of scale in training, and the problematic linkages with research that sometimes characterize decentralized systems, are likely to be present in this variant as well.

3.3 Fee-for-Service and Privatized Extension

A format of fee for service for extension (where the provider may be a public entity or private firms or consultants) in developing countries usually still entails considerable public funding even if the provider is private (e.g., in the form of government-funded vouchers or other government funding, such as reported by Keynan, Olin and Dinar (1997) and Dinar and Keynan (2001)), but it has the potential of reducing the fiscal burden of public extension services. Under such an arrangement, small groups of farmers typically contract extension services to address their specific information needs. The free-rider problems and nonrivalry in information use are resolved by defining the public good at the level of a small group, and having the whole group share in the cost. The difficulty of tracing extension impact is much less of a problem, although issues of asymmetric knowledge of the value of information and identifiability of benefits (Hanson and Just, 2001) will still be present and raise design challenges accordingly.

With the resolution of the accountability problem, the quality of service is likely to be higher. In fee-for-service modalities, farmers clearly determine the type of information that is of priority to them, and thus the impact of extension advice is likely to be the highest possible. Still, training and the update of skills will usually have to be undertaken by agents individually, with loss of economies of scale. These issues pose further design challenges. An important role for public extension and policy (such as has been supported by the World Bank in Latin America) is to facilitate the development of private provision of extension services, so that the public system can withdraw as appropriate. A key drawback of fee-for-service modes of extension is that less commercial farmers (i.e., poorer farmers and those farming smaller and less favored areas), for whom the value of information is lower, may purchase fewer extension services, as the price of the service will tend to be market-determined (thus reflecting also the demand from farmers with higher value of information, to the extent that such farmers use these channels for their information). This may entail not only social considerations, but may be an inefficient outcome if the poor have a lesser ability to prejudge the value of information and tend to undervalue it. The resolution of this concern is the stratification of extension systems by types of clients within the country (e.g., Sulaiman and Sadamate, 2000). That is, smaller and poorer farmers may be served by public extension, or by formats of contract extension receiving larger shares of public funding (e.g., an association of smaller farmers receives a larger matching allocation to hire extension

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staff). In such ways, the particular needs of women farmers, for instance, may be addressed (e.g., Saito and Weidemann, 1990). At the same time, commercial farmers are expected to pay a higher share of extension cost in a fee-for-service system (Wilson, 1991; Dinar and Keynan, 2001). Furthermore, as pointed out by Hanson and Just (2001), there may be several externalities (such as related to soil conservation) that imply inefficiency if a fully privatized extension system is introduced.

3.4 Farmer Field Schools

The farmer field school (FFS) was designed originally as a way to introduce knowledge on integrated pest management (IPM) to irrigated rice farmers in Asia. The Philippines and Indonesia were key areas in implementing this extension effort. Experiences with IPM-FFS in these two countries have since been documented and used to promote and expand FFS and FFS-type activities to other countries and to other crops. Currently, FFS activities are being implemented in many developing countries, although only a few operate FFS as a nationwide system.

A typical FFS educates farmer participants on agro-ecosystems analysis, including practical aspects of "...plant health, water management, weather, weed density, disease surveillance, plus observation and collection of insect pests and beneficials" (Indonesian National IPM Program Secretariat, 1991, p. 5). The FFS approach relies on participatory training methods to convey knowledge to field school participants to make them into "...confident pest experts, self-teaching experimenters, and effective trainers of other farmers" (Wiebers, 1993). A typical FFS entails some 9-12 half-day sessions of hands-on, farmer experimentation and non-formal training to a group of 20-25 farmers during a single crop-growing season. Initially, paid trainers lead this village-level program, delivering elements and practical solutions for overall good crop management practices. Through group interactions, attendees sharpen their decision making abilities and are empowered by learning leadership, communication and management skills (van de Fliert, 1993). Some of the participating farmers are selected to receive additional training so as to be qualified as farmer-trainers, who then take up training responsibilities (for some fee, possibly paid by their community) with official backup support such as training materials. While there is some debate on whether the FFS is an extension system or an informal adult education system, for purposes of our discussion, the distinction is not of much consequence, as the objectives of the FFS are similar to those of many extension systems. The approach whereby the training focuses more on decision making skills than on packaged messages is perceived by its proselytizers as superior to traditional extension methods.

A key weakness of extension organizations that the FFS seeks to rectify is accountability. This aspect is addressed in two ways: (i) The official trainers who conduct the field school are bound by a strict timetable of sessions within a prespecified curriculum, which can be easily verified by supervisors; and (ii) The continuous interaction with a cohesive group of trainees creates certain accountability to the group. This is further enhanced by the participatory nature of the training methods. Accountability to farmers is greatly enhanced when the training is administered by farmer-trainers, who are members of the same community. These features are thus expected to ensure the quality of the service (knowledge) provided to the farmers.

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The FFS design entails, however, some aspects that are likely to exacerbate the issue of financial sustainability, and that could eventually limit its impact. The intense training activities are expensive, per farmer trained (Quizon, Feder and Murgai, 2001a, 2001b), and thus imply that the amount of service actually delivered (i.e., the number of farmers trained) would be small when considered from a national perspective. Cost-effectiveness and financial sustainability could be improved if farmer-trainers were to become the main trainers, perhaps with significant community funding, and if informal farmer-to-farmer communications were to facilitate knowledge diffusion. As demonstrated by Quizon, Feder and Murgai (2001a), however, farmer-trainers have been quantitatively a minor factor in the national FFS initiatives in Indonesia and in the Philippines. Furthermore, as Rola, Jamias and Quizon (2002) concluded from their study in the Philippines, there is little diffusion of knowledge from trained farmers to other farmers, presumably because the content of the training (capacity for better decision making) is not easy to transmit in casual, nonstructured, communications. Therefore, concerns regarding the financial viability of the FFS (or, alternatively, regarding the ability to provide significant national coverage) are still pertinent.

4. The Impact of Extension

The extension operations of the past four decades may well be the largest institutional development effort the world has ever known. Hundreds of thousands of technicians have been trained; and hundreds of millions of farmers have had contact with and likely benefited from extension services. As countries struggle with declining public budgets, a key question must be "How effective have these extension investments been and what impacts have they had?" Not all good questions, however, have ready answers, in this case because of the many challenges of attribution and measurement that have been noted in earlier sections.

In principle, the economic analysis of extension projects is no different from that applicable to any investment appraisal (e.g., Belli et al., 2001) although there are inevitably many challenges to be faced in valuing and attributing benefits appropriately, and critics of much practice argue that many of the measurements and assumptions typically made are less than realistic, even if sometimes claimed to be conservative. For projects that deliver agricultural knowledge products to producers, various focused considerations can be taken, as reviewed by Maredia, Byerlee and Anderson (2001).

The latter authors address relatively comprehensive impact studies that seek to quantify effectiveness in terms of achieving the major objectives, especially the enhancement of productivity, as has been emphasized in above sections. Such enhancement is typically quantified in impact studies by estimating the economic benefits to producers (and more seldom consumers) and computing a rate of return (ROR) to the investment. There are two broad approaches to estimating RORs—the econometric approach that relates productivity changes to investment in research and extension, and the economic surplus method that builds benefits from the bottom up, based on estimated productivity changes at the field level and adoption rates for each technology. With the data limitations that so frequently have plagued the econometric approach, the economic surplus approach has been much more widely applied in developing countries.

Comprehensive studies may also seek to trace wider economic benefits of research and extension through factor and product markets. Also, economic analysts are increasingly being asked to address other objectives beyond efficiency, such as equity improvements and poverty alleviation, environmental quality, food safety, and nutrition (e.g., Alston, Norton and Pardey, 1995). The extent that research and extension organizations should depart from their traditional efficiency objective is much debated and there is yet no general resolution to guide, say, public policy analysts concerned with relevance and effectiveness of investment in research and extension. However, few studies have assessed extension achievements in their more comprehensive domains of ambition.

The econometric approach to impact assessment usually employs a production function, cost function, or a total factor productivity analysis to estimate the change in productivity due to investment in research and extension. The framework of, say, a production function incorporates conventional inputs (land, labor etc.), non-conventional inputs (education, infrastructure etc.), and the stock of technical knowledge (perhaps represented by some representation of investment in research and extension). Recent efforts have expanded the specification to include resource quality variables (e.g., soil erosion, nutrient status etc.), and weather variables. The estimated coefficients on research and extension (measuring marginal products) are then used to calculate the value of additional output attributable to the respective expenditures (holding other inputs constant) and to derive marginal RORs to the investments.

There are many technical areas of debate and refinement in the literature on econometric methods, such as the length and shape of time-lag structures, the appropriate method of determining the rate of return from the estimations, and the quality of indices used as the dependent variable (Alston, Norton and Pardey, 1995, have a comprehensive discussion). However, the main constraints on the wider application of econometric approaches in developing countries are data availability and quality. The econometric approach requires good-quality time-series data, which are difficult to obtain below the national or state level in most developing countries. Therefore, the approach is generally best for ex post evaluations of entire agricultural research and extension systems over a long period (say, 25-30 years), if the quantity and quality of data allow the use of statistical methods. Much of the work in this area in developing countries has been pioneered by Robert Evenson (e.g., various contributions in Evenson and Pray, 1991). The approach is less relevant for individual research and extension organizations since pertinent time-series data are rarely sufficiently long enough or complete enough or available at the needed level of disaggregation to allow useful estimation.

One good approach is to use panel data to capture both cross-sectional and time-series variability (e.g., Gautam, 2000). Secondary data of a panel nature are increasingly available for many of the variables at the district level, especially production and input data, and some recent studies have even included district-wise data on resource quality. Maredia, Byerlee and Anderson (2001) offer a review of such studies, although the emphasis in them has been on the impact of research rather than extension. As panel data become more widely available, the use of econometric approaches to research and extension evaluation will expand.

Birkhaeuser, Evenson and Feder (1991) made an early review of studies of extension impact and found few studies of systematic comparison of costs and benefits with and without a project. Systematic social experiments comparing different methods of extension in similarly

situated areas have yet to be carried out. Where extension programs have been evaluated by comparing outcomes in similar contiguous areas, the results have been nuanced. Thus, careful work by Feder and Slade (Feder and Slade, 1986; Feder, Lau and Slade, 1987) comparing productivity differentials in Haryana and Uttar Pradesh suggested that T&V had no significant impact on rice production but yielded economic returns of at least 15 percent in wheat growing areas. Similar work in Pakistan (Hussain, Byerlee and Heisey, 1994) found even smaller impacts in wheat areas, although the effect of T&V in increasing the quantity of extension-contact was documented. Although evaluations of extension investments have criticized the observed low levels of efficiency and frequent lack of equity in service provision, they have in the past reported relatively high benefit/cost ratios (e.g., Perraton et al., 1983).

More recent studies of extension impacts have also shown significant and positive effects (e.g., Bindlish Evenson and Gbetibouo, 1993; Bindlish and Evenson, 1993) and internal rates of return on extension investments in developing countries have reportedly ranged from 5% to over 50% (Table 3) (Evenson, 1997). The overriding lesson from Evenson's review of 57 studies of the economic impact of agricultural extension is, however, that impacts vary widely—many programs have been highly effective, while others have not. Extension systems seem to have been most effective where research is effective and have the highest pay-off where farmers have had good access to schooling, although doubtless other factors also play key roles.

Table 3: Estimated rates of return for economic impacts from extension in selected countries (number of countries).

Type of technological infrastructure in a country*	5-25%	26-50%	50%+
Traditional and emerging technology	0	1	9
Islands of modernization	1	1	4
Mastery of conventional technology	2	2	3
Newly industrialized	1	0	4
Industrialized	0	0	5

* Bangladesh, Botswana, Brazil, Burkina Faso, Côte d'Ivoire, Ethiopia, Indonesia, Japan, Malaysia, Nepal, Nigeria, Paraguay, Peru, Philippines, South Korea, United States and Thailand.

Source: Evenson (1997).

The most comprehensive review of impacts is found in a recent meta-study of 289 studies of economic returns to agricultural research and extension. This study found median rates of return of 58 percent for extension investments, 49 percent for research, and 36 percent for combined investments in research and extension (Alston et al., 2000).[1] Similar success has been

[1] The sample of studies reviewed in the meta-study was strongly oriented towards research, as only 18 out of 1128 estimates of rates of return were for "extension only". In contrast, 598 were for "research only" and 512 were for "research and extension combined".

documented even for Sub-Saharan Africa alone (e.g., Oehmke, Anandajayasekeram and Masters, 1997). Economic analysis has thus provided fairly strong justification for many past extension investments, but does not tell the full story.

Concern over data quality along with difficult methodological issues regarding causality and quantification of all benefits must, however, be important qualifiers to the prevailing evidence of good economic returns from extension. In Kenya, perhaps (from Leonard 1977, to Gautam 2000) the most closely studied case in developing countries, although previous evaluations had indicated remarkably high positive economic returns to extension investments, a comprehensive evaluation based on improved and new data revealed a disappointing performance of extension, with a finding of an ineffective, inefficient, and unsustainable T&V-based extension system and no measurable impact on farmer efficiency or crop productivity (Gautam, 2000). Such findings help to pose dilemmas for policy makers whose skepticism (reinforced by observations such as those of Hassan, Karanja and Mulamula, 1998) about getting returns to investment in public extension that are actually rather low, seems more than well justified. It is not our intention to end this survey on a note so salutary but evidently more evaluative work is called for to better assist policy insights and investment decisions.

5. Conclusion

Our review began by charting the important role that agricultural extension can play in development. We especially highlighted the public-good character of much actual and potential extension effort, as this underpins the extensive public investment in this domain.

We took pains to point out the many administrative and design failures that have proved so problematic in public extension effort in the past, most notably those associated with: the scale and complexity of extension operations; the dependence of success in extension on the broader policy environment; the problems that stem from the less than ideal interaction of extension with the knowledge generation system; the difficulties inherent in tracing extension impact; the profound problems of accountability; the oftentimes weak political commitment and support for public extension; the frequent encumbrance with public duties in addition to those related to knowledge transfer; and the severe difficulties of fiscal unsustainability faced in many countries.

From our review of such problems, as well as due consideration of positive experience, we went on to chart solutions that can assist future extension endeavor, including reflection on the pros and cons of the specific formats of extension operations that have emerged in the past few decades, namely Training and Visit extension, decentralized mechanisms for delivery, fee-for-service and privatized extension, and Farmer Field Schools. Naturally, specific situations will call for quite specific servicing methods but our review emphasizes the efficiency gains that can come from locally decentralized delivery with incentive structures based on largely private provision, much of which will inevitably remain largely publicly funded extension efforts, especially (and properly so) for impoverished developing countries.

There is clearly much yet to be done in bringing needed extension services to the poor around the world. But investors need to be cautious in designing and adjusting public extension systems if they are not needlessly to re-learn the lessons of the past. Informed by these lessons

governments should be able to increase the chance of reaping high returns to their investment and successfully assisting farmers to boost their productivity and income, and thereby contribute more strongly to economic growth.

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